STATEWIDE INTEROPERABILITY GOVERNING BOARD

Operations and Maintenance Working Group

November 2014

Public Safety Land Mobile Radio System Operations and Maintenance Plan

PURPOSE

The Statewide Interoperability Governing Board (SIGB) was established on September 30, 2011. The SIGB was continued by Governor Steve Bullock through Executive Order No. 10-2013 (EO), which was executed on October 1, 2013. As provided in the EO the purpose of the SIGB is to plan, develop and promote public safety interoperable communications in Montana.

The EO directs the SIGB to engage all public safety stakeholders in the development of a long-term, viable plan for the ongoing operation and maintenance of the public safety land mobile radio (LMR) system in Montana. The Statewide Public Safety Communications System is an industry standards (APCO P25) compliant, trunked land mobile radio system. The system provides operational, tactical and interoperable communications for federal, state and local agencies. The system currently has approximately 6,000 federal, state and local subscribers. The system's initial deployment began in 2003.

The SIGB formed an operations and maintenance working group in the summer of 2014 and tasked the group with vetting the operations and maintenance requirements of the system and drafting a plan that includes recommendations to the SIGB for consideration and adoption. This document completes these tasks that were assigned to the operations and maintenance working group.

The plan begins with background or an overview of land mobile radio (LMR) systems and trunked LMR systems; identifies the components or subsystems of the Public Safety Communications System; identifies each subsystem's operations and maintenance requirements and concludes with recommendations for the operations and maintenance for each subsystem.

The plan considers the system in its current state as of October 2014; covers a four year planning horizon for the time period 2016 – 2020 and includes "budgetary estimates" that can be used to secure the required financial resources to implement the recommendations included in this plan.

BACKGROUND

LAND MOBILE RADIO 101

What is a Land Mobile Radio System?
The Federal Communication Commission (FCC) defines a land mobile radio system as a regularly interacting group of radio base, mobile, and associated control and fixed relay stations intended to provide LMR communications service over a single area of operation. The term mobile refers to movement of the radio, rather than association with a vehicle; hence mobile radio encompasses handheld and portable radios.

Land Mobile Radio System Components
In general, the following are basic elements of all LMR systems:

- Communication Site Infrastructure:
- Communication Site Radio Equipment (Radio Subsystem)
- Dispatch Subsystem
- Subscriber Radio Subsystem
- Transport Subsystem

<u>Communication Site Infrastructure</u>:

- Land
- Tower
- Antennas
- Building
- Power, Electrical & Grounding
- Heating, Ventilation and Air Conditioning Systems (HVAC)

<u>Communication Site Radio Equipment (Radio Subsystem)</u>
In general, the primary radio equipment located at each communications site includes radio base stations/repeaters. A radio base station is a fixed radio used to communicate (transmit/receive) to other fixed, mobile or portable radios. A repeater is a combination receiver and transmitter that is designed to extend the range of the communication without degradation.

Dispatch Subsystem

Public safety LMR systems have a fixed dispatch location (aka dispatch center) that is staffed 24/7 by dispatchers. Dispatchers receive 9-1-1 calls from individuals who need assistance from emergency responders (Firefighters, Police Officers and Emergency Medical Services). Once information is obtained from the caller, dispatchers communicate with the required emergency responders to provide the services necessary to respond to the call for help.

The communications equipment that primarily constitutes the dispatch subsystem is the operator console or “dispatch console”. The dispatch console is the user interface the dispatcher uses to receive and transmit communications and to connect (“patch”) radio channels.

When an LMR system includes multiple radio channels and requires that all channels have dedicated dispatchers on duty at all times, console positions are required. A dispatch center can be as small as one position with one person operating the equipment. Or it can have multiple consoles (or console positions), with hundreds of channels and/or talk groups.

Subscriber Radio Subsystem

The subscriber radio subsystem includes mobile and portable radios to enable communications by system users (emergency responders). Mobile radios are vehicle-mounted radios, while the "walkie-talkie" radios are called portables.

Conventional vs Trunked LMR Systems

"Trunked" radio systems differ from "conventional" radio systems in that a conventional radio system uses a dedicated channel (frequency) for each individual group of users, while "trunking" radio systems use a pool of channels which are available for a great many different groups of users.

For example, if police communications are configured in such a way that ten conventional channels are required to permit citywide dispatch based upon geographical patrol areas, during periods of slow dispatch activity much of that channel capacity is idle. In a trunked system, the police units in a given geographical area are not assigned a dedicated channel, but instead are members of a talk-group entitled to draw upon the common resources of a smaller pool of channels.

Trunked radio takes advantage of the probability that with any given number of user units, not everyone will need channel access at the same time, and therefore fewer discrete radio channels are required. From another perspective, with a given number of radio channels, a much greater number of user groups can be accommodated.

When multiple agencies share systems or when there are a large number of subscribers on a system, then a trunked LMR system will provide a better quality of service for the users. Generally speaking, the more users that you have; the more advantageous the use of the trunking technology becomes.

In addition, at the present time the land mobile frequency spectrum is very crowded and additional frequencies are difficult to obtain. Spectrum scarcity is the one of the primary reasons that public safety agencies use trunking technology and deploy trunked LMR systems.

Trunking is the commonly accepted term for electronically controlled sharing of a relatively small number of communications channels among a relatively large number of users. In general terms, a trunk is a shared voice or data traffic path between two points. Trunked LMR systems use “control subsystems” to share channel capacity among many users. The electronic control enables users to take advantage of the fact that some transmitted channels are idle at a particular time while others are busy. This is in contrast to a conventional system, where the users exercise their own coordination regarding access to system resources, by listening for idle time and making manual channel selections.

In essence, a trunked LMR system is a packet switching computer network and the system “zone controller” is the centralized processor of the system. The controller communicates with the units by way of the control channel. All other channels act as repeaters for communications between user radios. When user radios are not communicating, they continuously monitor the control channel. When a user radio (subscriber radio) needs to communicate, it sends out a channel request on the control channel. This request includes the ID of the talk group with which the subscriber radio wants to communicate. The system controller checks whether a vacant channel is available or not, and sends instructions to subscriber radios on the control channel.

It should be noted that the statewide public safety LMR system is “conventional” and “trunked” capable. All dispatch console (described below) activity including trunked and conventional audio, is supported by the system IP network. Conventional channels link to the IP network and use the same audio transport as trunked audio.

Trunked LMR: Control Subsystem

The control subsystem is referred to by Motorola Solutions as the “Master Switch” or “Master Site”, which includes the hardware and software required to operate the radio subsystem. The Master Site is the central point for all system traffic in each zone.

Control Subsystem (Master Site) Components

- Zone Controller - is a redundant processor that provides trunking call processing to support system operations.
- Network Management System - is a set of software applications (servers) that manage the trunked LMR system and its constituent components required for user management, system management, fault management, and performance management.

Trunked LMR: Radio Subsystem

The radio subsystem for a trunked LMR system compared to a conventional system requires additional technology at each radio site to support the trunking operation. In general trunked radio site equipment includes the following:

- Base Station Radios - trunked radio sites have groups of base station radios that are configured as repeaters.
- Site Controllers - maintain the connection/link and communication with the Zone Controller.
- Antenna Combining System – allow multiple transmitters to share the same antenna, maximizing tower utilization, reducing tower loading and reducing interference risk.
- Switches - are a computer networking device that connects devices together on a computer network, by using a form of packet switching to forward data to the destination device. Switches allow different nodes (a network connection

point) of a network to communicate directly with one another in a smooth and efficient manner.

- Routers –forward data packets along computer networks. A router is connected to at least two computer networks. Routers are located at gateways, the places where two or more networks connect.
- Electrical Rectifier & Inverter – A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. An inverter is an electrical device that changes direct current (DC) to alternating current (AC).

Trunked LMR: Transport Subsystem

A wide-area trunked LMR system requires that the radio, dispatch and control subsystems be connected or "linked". There are several different technologies, methods and tools to connect/link the radio, dispatch and control subsystems, which include microwave (MW) and telecommunications circuits.

Microwave

The use of MW radio is a common means of connecting radio, dispatch and control subsystems. Typical microwave systems often consist of an indoor unit (IDU) located inside of a building and a corresponding outdoor unit (ODU) located on the building rooftop or on a tower. The IDU and ODU will be typically be interconnected via an Ethernet cable that carries the information between the IDU and the ODU.

Telecommunication Circuits

Telecommunications circuits are also one of the common methods of connecting/linking communications systems together.

The selection of one technology or method is typically site specific and requires the vetting of each communications site's requirements and cost/benefit factors to determine the appropriate technology or method.

STRATEGIC FACTORS

In developing an Operations and Maintenance Plan for the statewide trunked LMR system, the following have been identified as critical factors that will have a significant impact on the plan and the future operations and maintenance of the system. These factors require a careful examination and understanding.

Strategic Factors:

- "System of Systems";
- Standards-Based System & Equipment; and
- Single-Band: VHF Spectrum

<u>System of Systems</u>

Based on stakeholders' requirements of control, autonomy and leveraging existing infrastructure and systems, a "system-of-systems" (SoS) strategy was adopted in deploying the statewide LMR system.

The SoS strategy consists of multiple individual LMR systems interconnected together for improved interoperability, mobility and the sharing of system's assets and the their related cost. The SoS strategy supported the initial capitalization of the systems through the use of federal grant funding. For example, eligible end-recipients of U.S. Department of Homeland Security (DHS) grants are local governments. Local governments used DHS grant funding to deploy an individual LMR system and "interconnect" their system to other systems to support the SoS strategy.

In contrast a "single system strategy" does not require an "interconnect" subsystem and typically provides the highest level of functionality, mobility and interoperability. Users can seamlessly roam throughout a county, region, statewide, etc. A single system strategy centralizes system ownership, operations, maintenance and control. "Cons" of a single system strategy typically include loss of local/agency autonomy and control, total cost and limited funding options.

<u>Standards-Based</u>

The statewide trunked LMR system meets Association of Public Safety Communications Officials (APCO) Project 25 (P25) industry standards. P25 is an open standard for producing digital LMR system infrastructure and subscriber equipment. P25 technology is available in multiple frequency bands and is provided by multiple manufacturers.

P25 standards were developed by committees of manufacturers, system operators, and industry associations, guided by a steering committee of public safety and federal government radio system users. This standard provides guidelines for the design and manufacturing of equipment that conforms to a suite of minimum operational requirements.

The P25 standard requires that equipment must provide backward compatibility to enable conventional analog system access. This requirement provides users with a migration path from a legacy analog system to a P25 digital system. P25 supports wide-area system access in both conventional and trunked architectures.

The system's current version (Release 7.11) includes Motorola proprietary elements, but as the system is updated, it could include the P25 Inter-Sub-System-Interface (ISSI). ISSI will allow P25 compliant systems from different vendors to interface/connect with one another.

Single-Band: VHF Spectrum

The design for the statewide LMR system includes the use of a single Very High Frequency (VHF) band. VHF is typically considered to be 150 MHz to 174 MHz.

The VHF band is heavily used by LMR systems throughout the nation and Montana. VHF is a popular band for rural areas because the VHF band has very good propagation over long distances and requires fewer sites than would be needed using other higher frequency bands (ex: 700/800 MHz).

Most public safety agencies in Montana are small in size but are responsible for large geographical areas. Frequently the availability of suitable radio sites for infrastructure is limited due to a number of factors such as environmental constraints, power availability, and site access issues. These constraints along with cost drive the need to cover the largest area with the fewest sites.

One of the issues with the VHF band is that it is not a "structured band". For radio repeater operations, a channel is composed of two frequencies. One frequency, called "base transmit" or "mobile receive," is the frequency used for the repeater to transmit to a mobile or portable radio. The other frequency, known as the "base

receive" or "mobile transmit," is the frequency used to transmit from the mobile to the repeater. Together, these are called a "channel pair" or "frequency pair."

Pairing two frequencies can be easy or difficult depending on many factors. For the 700 MHz, and 800 MHz radio bands, the task of pairing frequencies has already been completed by the FCC in its Rules and Regulations, in which the FCC has assigned a base transmit and base receive pair for every channel. The separation between transmit and receive frequencies follows a standard established by the FCC.

Pairing frequencies in the VHF band, however, can be a more difficult task. The FCC established the VHF bands before repeaters were invented, and standard transmit and receive pairs have never been specified. Therefore VHF systems operators are forced to identify available frequencies and choose two to use for transmit and receive. The separation between transmit and receive is not standard, and pairing requires additional engineering and examination of the potential for interference with other licensees on or near the selected frequencies.

In summary, utilizing a single VHF band provides a larger coverage area and lower total system costs, but due to its history and popularity VHF frequencies are very scarce, require more complex engineering and are more prone to interference issues. As a result, adding additional channel capacity to the system at an individual communications site in the future could be very difficult and expensive. Therefore the use of the 700/800 MHz spectrum may need to be considered in the future.

STATEWIDE TRUNKED LMR SYSTEM CHARACTERISTICS

The statewide P25 trunked LMR system has the following major characteristics:

- Control Subsystem: 2 Regional Master Sites
- Radio Subsystem: 56 Trunked Radio Sites
- Dispatch Subsystem: 10 Dispatch Centers
- Subscriber Subsystem: 6,000 Subscriber Units
- Transport Subsystem: Statewide MW Network & Telecommunications Circuits

Control Subsystem: Regional Master Sites

The statewide trunked LMR system includes two regional Master Sites. The western master site is located in Helena and is owned, maintained and operated by Lewis and Clark County. The eastern master site is located in Sidney and is owned, maintained and operated by Richland County. The western and eastern master sites are connected and this interzone connection requires four T1 links. Interconnecting the two master sites or "zones" allows seamless roaming for subscribers (users).

It should be noted that there is a key difference between the western and eastern master sites, which includes the User Configuration Server (UCS). The UCS is only deployed at the western master site. The UCS provides the following for both the western and eastern zone: configuration of user security information, zone maps, users, radios, and talk groups. In order for the eastern master site to perform all system control functions, completely independent of the western master site, it would require an upgrade to include the UCS.

Radio Subsystem: Trunked Radio Sites

The western master site or "Zone #1" has 43 trunked radio sites. An equipment ownership breakout by County/Agency is provided below:

County/Agency Name	# of Trunked Radio Sites
Lewis & Clark County	8
Flathead County	7
Gallatin County	5
Butte – Silver Bow	2
Cascade County	2
Montana Highway Patrol	2
All Other (1 Site Per County)	17
TOTAL	**43**

The eastern master site or "Zone #2" has 13 trunked radio sites. An equipment ownership breakout by County/Agency is provided below:

County/Agency Name	# of Trunked Radio Sites
Richland County	3
Dawson County	2
Roosevelt County	2
Valley County	2
All Other (1 Site Per County)	4
TOTAL	**13**

Dispatch Subsystem: Dispatch Centers

The western master site or "Zone #1" has 9 dispatch centers connected to the system, located at the following 9-1-1 dispatch centers:

- City of Helena - Lewis & Clark County
- Flathead County
- Gallatin County
- Central Montana – City of Lewistown – Fergus, Judith Basin, Petroleum Counties
- Butte – Silver Bow
- Blaine County
- Great Falls – Cascade County
- Hill County
- Montana Highway Patrol

The eastern master site or “Zone #2” has 1 dispatch center connected to the system that is located at the Richland County dispatch center in Sidney, MT.

Subscriber Subsystem: Mobile & Portable Radios

There are approximately 6,000 subscriber units authorized on the system. From a system usage and local and statewide perspective: local emergency response agencies in Lewis & Clark County, Flathead County and the City of Great Falls are the primary users; outside of these local areas the Montana Highway Patrol is the primary statewide user.

SYSTEM OPERATIONS & MAINTENANCE STATEGIES & RECOMMENDATIONS

Governance & Organizational Strategies & Recommendations

Currently the statewide system is a “system-of-systems” and a vast majority of the systems assets are owned, operated and controlled at the local government level. The system owners do not have a single centralized administrative, operational and maintenance entity. Best practices for “system-of-systems” include the development and execution of inter-local agreements, which creates the legal framework for the roles and responsibilities for each local government owner. In addition, most locally owned and operated regional “system-of-systems” form administrative and operational entities, typically known as “authorities”, through inter-local agreement.

The system authority’s governance typically follows a corporate structure with a Board of Directors and a User Committee that reports to the Board.

Recommendation(s):

1a) Local governments that own, operate and control system assets should work together to develop and execute inter-local agreements that clearly identify the administrative, operations and maintenance roles and responsibilities of each local government entity. The Montana Association of Counties (MACO) could be a valuable resource in this process in providing guidance and legal advice.

1b) Local governments that own system assets should work together to develop and execute an inter-local agreement to establish an "authority" that would be responsible for the administration, operations and maintenance of the system. MACO could be a valuable resource in this process in providing guidance and legal advice.

There are several "best practice" examples across the nation that could be used as a benchmark for the governance strategies above, including the Los Angeles Regional Communications System (LA-RICS) and LA-RICS Authority and Bay Area Regional Communications System (BayRICS) and BayRICS Authority.

2) The local governments that own system assets could migrate to a "single system" strategy. This would probably require engaging a single state agency (ex: Montana Highway Patrol) in the transfer of the ownership of the system's assets, specifically the control, radio and transport subsystems, from local governments to the state agency. The state agency would become the single, centralized entity that would be responsible for system administration, operations and maintenance and local governments and their agencies would be subscribers/users of the system.

There are several "best practice" examples across the nation that could be used as a benchmark for this strategy, including the states of North Dakota, Wyoming, Utah and Nebraska.

<u>Subsystem Strategies and Recommendations</u>

The statewide trunked LMR system is a Motorola Solutions, Inc. (MSI) ASTRO 25 trunked LMR system. The current version of the system includes MSI proprietary technology, which requires specific subsystem equipment and components to ensure seamless integration and operation of the system.

Control Subsystem: Regional Master Sites Maintenance

The hardware and software that comprise the control subsystem requires scheduled upgrades by MSI. The system was upgraded to version 7.11 in 2014. In general the version number can be related to the year that it was released. For example, version 7.11 was released by MSI in 2011. Due to third-party OEM hardware and software support, MSI typically recommends a five year life-cycle between version upgrades,

as beyond five years there is typically no third-party OEM software patch support and limited hardware support.

Following this recommended lifecycle Version 7.11 should be upgraded to version 7.14 by the end of 2017 and 7.14 should be upgraded to 7.16 by the end of 2019.The proposed upgrade from version 7.11 to 7.14 has an estimated cost of approximately $2.1 million and the upgrade from version 7.14 to 7.16 has an estimated cost of approximately of $2.650 million.

Recommendation(s): Follow MSI's recommended lifecycle and complete the upgrades to the control subsystem hardware and software as outlined above.

Radio Subsystem: Trunked Radio Sites

The primary equipment that constitutes the radio subsystem is approaching end-of-support and end-of-life. Specifically the base/station repeaters located at 40 or the 56 communications sites require replacement. These base stations/repeaters are no longer produced by MSI, as of 2011, and MSI has identified the end of 2020 as the end-of-support for this equipment. The estimated total cost for replacing the base station/repeaters is approximately $3.2 million.

End of support means that the manufacturer/vendor will no longer maintain the equipment, repair failed components, or provide technical "help desk" support. Equipment must be upgraded or replaced before support ends to avoid the elevated risk of degraded performance or failure.

Until equipment can be replaced the use of MSI extended warranties that include technical support, repair and replacement for all critical radio subsystem equipment could be utilized. Extended warranties support the mitigation of system operational and financial risk. The estimated cost for a 2-year warranty period for critical radio subsystem equipment is estimated to cost $500,000.

In addition, other communication site equipment is nearing end-of-life, the electrical rectifiers and inverters for example. It is also "best practice" to replace antennas, cabling and antenna combining systems when replacing the base station/repeaters. The estimated total cost for replacing electrical rectifiers and inverters, antennas, cabling and antenna combining systems is $2.0 million.

Recommendation(s): Continue the use of MSI extended warranties for critical radio subsystem equipment and replace all end-of-support base station/repeaters by the end of 2019.

Due to the size and complexity of the system and location of the communications sites, the replacement or upgrade of the system equipment is projected to be a four year project. Many of the communications sites are "mountain top" sites that due to their high elevation and extreme weather conditions are only readily accessible during a 6 month period (May – October) every calendar year. Therefore the proposed equipment replacement project should take a phased approach by replacing the oldest, highest risk equipment first to begin decreasing risk sooner.

Dispatch Subsystem: Dispatch Centers

MSI requires specific dispatch consoles (MCC 7500) to support seamless integration with the system. The MCC 7500 consoles connect directly to the IP network without interface boxes, digital voice gateways or backroom electronics for an integrated system. Conventional channels link to the IP network and use the same audio transport as the trunked audio.

The dispatch subsystem currently includes nine MCC 7500 consoles located at various 9-1-1 dispatch centers and one Gold Elite console located at the Montana Highway Patrol's dispatch center in Helena.

Recommendation: Regarding connecting additional dispatch centers and the operation and maintenance of the dispatch subsystem; the system owners and users should develop and adopt a "bring your own technology (BYOT)" policy. A BYOT policy should include terms and conditions for connecting to the system and the purchase, operations and maintenance of the dispatch center/console is the responsibility of the user.

It should be noted that the Montana Highway Patrol (MHP) is currently operating a Gold Elite console that will not be supported by MSI once the control subsystem is upgraded to version 7.15. MHP will be required to upgrade the console to a MCC 7500 console that is estimated to cost $1.5 million.

Subscriber Subsystem: Mobile & Portable Radios

Subscriber devices (mobile and portable radios) also follow a life-cycle or become non-operational due to the harsh environment that emergency responders work in. In general it is estimated that system users will need to replace approximately 8% of their subscriber units annually. Based on the current 6,000 subscriber units; 480 subscriber units per year require replacement at an average cost of $4,000 per unit, for a total cost of $1.920 million annually.

Recommendation: Regarding the procurement, provisioning of new or replacement subscriber units and maintaining the subscriber subsystem, the system owners and users should develop and adopt a "bring your own technology (BYOT)" policy. A BYOT policy should include terms and conditions for subscriber unit standards, being provisioned onto the system and that the purchase, operations and maintenance of each user agency's mobile and portable radios is the responsibility of the user agency.

OTHER OPERATIONS & MAINTENANCE STATEGIES & RECOMMENDATIONS

Infrastructure

The radio subsystem that is located at the 56 communications sites spread across Montana is co-located at/on communication site infrastructure that is primarily owned and maintained by local governments. Communications site infrastructure does require regular maintenance and life cycle replacement. As the 56 communications sites that support the system have all been constructed or improved over the last ten years, no life cycle replacement has been identified over the planning time period. Regular operation and maintenance requirements were modeled and include the following:

	Repair %	Cost Per Item	Annual Cost
SITES Maintained	**56**		
Generator	5%	28,000	78,400
Generator Service	100%	50	2,800
Tower Inspection	50%	2,000	56,000
Tower (damage/wear)	10%	3,000	16,800
Telco (Non-MW Transport)	5%	800	26,880
Power	per month	150	100,800
Heat/AC Service	100%	50	2,800
Site Monitoring		1,500	1,500
Lease Cost	50%	4,000	112,000
Site Access Cost	20%	150	1,680
Monitoring	100%	120.00	6,720
UPS Battery BU	2	4,000	8,000
Insurance Cost	100%	1,800	100,800
Weather Damage	10%	3,000	16,800
TOTAL			**876,156**

Recommendation: As the infrastructure is primarily owned by local governments the regular maintenance and life cycle replacement of the communications site infrastructure is the responsibility of infrastructure owner.

System owners and users should develop standard co-location or communication site lease agreements with the infrastructure owners. MACO could be a valuable resource in this process in providing guidance and legal advice.

Technical Services (Regular Maintenance)

The radio and transport subsystems require regular ongoing maintenance of the equipment located at each communications site. The regular maintenance is performed by radio technicians that are deployed for a specific issue or visit each communications site on a scheduled basis. This regular maintenance is categorized as "technical services". The required technical services were modeled and include the requirements outlined below:

Replacement Parts	Annual Replacement %	Per Unit Cost	Total Cost
LMR Radio	5%	26,000	72,800
Antennas	15%	900	7,560
Transmission Lines	5%	2,500	7,000
Combiners	2%	800	896
MUX Gear	5%	7,000	19,600
Microwave Batteries	30%	9,200	154,560
Poly Phasers	15%	200	1,680
Switches, Routers, Controllers	3%	1,000	1,680
Microwave Dish	5%	12,000	33,600
Microwave Radio	8%	10,000	44,800
TOTAL			**344,176**

	Costs Per Employee/Unit	2016	2017	SFY 2017 Biennium		2018	2019	SFY 2019 Biennium
Employees		**4**	**4**			**4**	**4**	
Salary w/Benefits	$ 80,000	$ 320,000	$ 320,000	$ 640,000		$ 320,000	$ 320,000	$ 640,000
Technician Equipment	$ 50,000	$ 200,000	$ -	$ 200,000		$ -	$ -	$ -
(One time purchase)								
Monthly Cell Contract	$ 150.00	$ 7,200	$ 7,200	$ 14,400		$ 7,200	$ 7,200	$ 14,400
Annual Equipment Replacements	$ 4,000	$ 16,000	$ 16,000	$ 32,000		$ 16,000	$ 16,000	$ 32,000
Annual Tech Training	$ 5,500	$ 22,000	$ 22,000	$ 44,000		$ 22,000	$ 22,000	$ 44,000
Travel Per Diem	144	$ 86,400	$ 86,400	$ 172,800		$ 86,400	$ 86,400	$ 172,800
Travel Days	150							
Subtotal		**$ 651,600**	**$ 451,600**	**$ 1,103,200**		**$ 451,600**	**$ 451,600**	**$ 903,200**
Vehicles								
3/4 Ton 4x4 Truck	$ 60,000	$ 240,000	$ -	$ 240,000		$ -	$ -	$ -
Fuel Cost per Year								
MPG	10	$ 24,000	$ 24,000	$ 48,000		$ 24,000	$ 24,000	$ 48,000
Price per Gallon	$ 4.00							
Miles per Year	15,000							
Annual Vehicle Maintenance	$ 2,500	$ 10,000	$ 10,000	$ 20,000		$ 10,000	$ 10,000	$ 20,000
Subtotal		**$ 274,000**	**$ 34,000**	**$ 308,000**		**$ 34,000**	**$ 34,000**	**$ 68,000**
GRAND TOTAL		**$ 925,600**	**$ 485,600**	**$ 1,411,200**		**$ 485,600**	**$ 485,600**	**$ 971,200**

Recommendation(s): Centralizing technical services would be the most efficient and cost effective organizational model. In addition, as the technical services are a "statewide" support service, it is recommended that the technical services operation be located within one state agency (ex: Montana Highway Patrol).

FUNDING MODEL

Federal grant funding should be pursued for eligible uses, such as specific equipment replacement. It should be noted that federal grant sources are becoming increasingly scarce. For example, grant funding through the U.S. Department of Homeland Security has realized an approximate reduction of 70% since its peak several years ago. State and local tax dollar appropriations will be required to fund the ongoing costs of the maintenance of the existing equipment as well as replacement of equipment nearing the end of its usable life.

Recommendation(s): Federal grant funding should be pursued where eligible and appropriate. State appropriations will be necessary for significant system maintenance costs such as control subsystem upgrades and replacement of radio subsystem equipment. The technical services program should be part of a single state agency's budget request and budget requests for subscriber radios should be included in each individual agencies budget.

Local jurisdiction's funds will be necessary to fund the costs of the subscriber and dispatch subsystems as well as Infrastructure Routine maintenance.

The table below represents the estimated costs for the Operating and Maintenance of the current LMR radio system as well as the proposed responsible parties.

	2016 – 2017	2018 - 2019	Responsible Jurisdiction
Control Subsystem Hardware & Software Upgrade	$2,100,000	$2,650,000	State
Radio Subsystem Equipment Replacement & Warranty			
Base Station Repeaters	$1,600,000	$1,600,000	State
Other Communications Site Equipment	$1,000,000	$1,000,000	State
Extended Warranty Services	$ 500,000	$ 500,000	State
Dispatch Subsystem: MHP Upgrade	$1,500,000		MHP
Subscriber Subsystem	$3,840,000	$3,840,000	Fed, State & Local Agencies
Infrastructure Routine Maintenance	$1,800,000	$1,800,000	Local Govt
Technical Services Routine Maintenance			
Personnel and Operating Budget	$1,411,200	$ 971,200	MHP
Replacement Parts	$ 700,000	$ 700,000	MHP
TOTAL ALL O&M REQUIREMENTS	**$14,451,200**	**$13,061,200**	

Based on this model we would recommend two or perhaps three separate appropriations be advanced in the 2015 Legislature. The first would be to the Montana Highway Patrol to fund the Radio Subsystem (communications site radio equipment) replacement; Dispatch Subsystem upgrade for the DOJ/MHP and the Technical Services Routine Maintenance program. Since the MHP is the state agency most reliant on this system and it already operates a statewide radio maintenance program, it is a logical state agency to place in charge of the recurring maintenance of the system.

A second appropriation will be necessary to fund the warranties on the radio subsystem (communications site radio equipment) as well as the Control Subsystem Hardware & Software Upgrade. This will need to be structured as a grant program to counties to reimburse the cost of the warranties since as the counties will need to pay for the warranties as the owners of the equipment. Over time as the existing communications site radio equipment is replaced, we would recommend that the state become the owner of the equipment when possible.

A third appropriation may be required to assist counties that lack the financial and technical ability to maintain the Infrastructure component that they own. There are several examples of towers necessary to the operation of the statewide system being owned by counties that derive no benefit from the statewide system. In these cases, the counties are hard pressed to justify the expense of maintaining these towers and support the system. This third appropriation could be used to fund a third party to maintain these sites. Alternatively, the state could give counties an opportunity to transfer the ownership of these assets to the state in which case the funds would be transferred back to the Highway Patrol as the new owner.